

California Department of Agriculture

BULLETIN

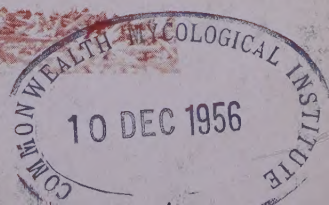
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*A Poultry
Inspection System
for California*



STATE OF CALIFORNIA
 GOODWIN J. KNIGHT, Governor
 HAROLD J. POWERS, Lieutenant Governor

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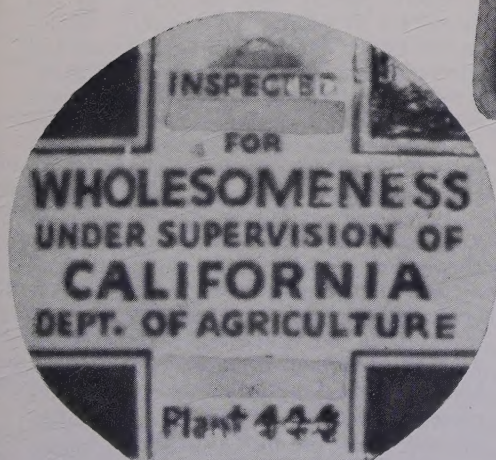
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The *Quarterly Bulletin*, published as a contribution to the welfare of California Agriculture, is mailed free to California citizens interested in the work of the Department of Agriculture. The *Bulletin* is exchanged, on request, for publications of the Federal Government, Experiment Stations, and other state or national agricultural offices or organizations. Entered as second class matter, October 6, 1919, at the U. S. Post Office, Sacramento, California, under the Act of Congress, June 6, 1900. Address communications to: Editor, the *Quarterly Bulletin*, California Department of Agriculture, 1220 N Street, Sacramento, California.

California's Poultry Meat Inspection System

By DR. J. E. STUART, Chief
Division of Animal Industry

As a result of laws enacted during 1955 and 1956, California now leads all other states in the field of mandatory licensing and sanitary standards for poultry and rabbit meat processing plants, and in the inspection of poultry and rabbit meat for wholesomeness.



This greatly enlarged replica of a wing tag, left, may be used, as on the packaged meat above, to display the mark of inspection required by California's new poultry laws



Exterior of a typical California poultry plant

Under the new laws, the California Department of Agriculture and the state-wide poultry industry together have begun organization of a poultry meat inspection service, to the direct and immediate benefit of both consumers and the industry as a whole. The newly authorized inspection service will provide an opportunity for this important segment of the food industry in California to standardize sanitation, wholesomeness and labeling requirements.

The inspection service now being organized is designed to provide adequate inspection for wholesomeness and sanitation in an estimated 1,000 California plants where poultry and rabbits are slaughtered or poultry meat processed. More than 1,000 inspectors must be trained and supervised. When it is realized that there are only 279 plants throughout the entire United States now operating under federal inspection for wholesomeness, the tremendous scope of the California program may be fully appreciated. It is a huge undertaking which challenges the imaginative and creative resources of all participating groups.

A Giant-size Industry

The value of all chickens, turkeys and rabbits produced in California for meat purposes during 1955 was estimated at \$115,877,200. This giant-size industry generally had not operated under compulsory inspection prior to July 1st, 1956.

It is reported that 40 percent of the dressed poultry consumed in California is shipped from other states for marketing here. More than 50 percent of these imports is federally inspected before shipment. Most

of this poultry, 85 percent of which is chicken, is fully drawn and packed with ice in crates for shipment by refrigerated truck to California markets. Principal supplier states are Georgia, Alabama, Mississippi, Louisiana, Texas, and Arkansas. Upon arrival in California, poultry carcasses are cut up and tray-packed for retail distribution. Such imports now have reached the dollar value and volume of big business, and are increasingly important to the economy of supplier states. Equitable procedures for approval of out-of-state inspection services are now being developed, as a result of problems already encountered by the infant California inspection service. Undoubtedly the new laws here will significantly affect poultry meat processing and inspection in all supplier states.

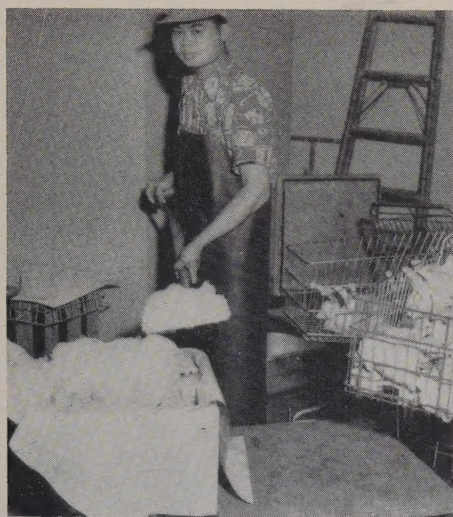
National Interest in Poultry Laws

Increased interest in inspection and sanitary handling of poultry and rabbit meat is evidenced by the fact that the number of states which enforce poultry laws or regulations of some kind has increased from a total of 21 during 1946 to 42 during 1954. Furthermore, during 1954, 31 states had requirements dealing with sanitation, equipment and methods.

Total number of plants operating under federal inspection has increased from 146 during 1951, to 279 during 1955—almost a 100 percent increase in five years. The federal inspection service is voluntary, and is paid for by plant operators.

Federal poultry meat inspection has operated for 27 years. It is presently administered by the Poultry Division, Agricultural Marketing Service, United States Department of Agriculture. During 1955, an estimated 25 percent of all poultry processed in the United States was under federal inspection; only 36 California plants operate under the system.

During the Second Session of the 84th Congress, much interest was focused upon compulsory inspection of poultry moving in interstate commerce. Although several bills relating to poultry inspection were introduced in the Congress, none received final action during the session. The desirability of federal legislation is generally accepted, in order to require all poultry shipped interstate to be produced under rigid sanitation and inspected for wholesomeness.



Ice packing of whole eviscerated chickens facilitates shipment of the product for marketing in wholesale trade

California Poultry Legislation

During its 1955 Session the California Legislature enacted two laws, which specify: (1) licensing and sanitary requirements of poultry slaughtering plants; and (2) statewide inspection of dressed poultry and rabbits for wholesomeness prior to sale. Enforcement was assigned to the California Department of Agriculture.

The measures were introduced by Senator John A. Murdy as Senate Bills 1555 and 1633; Governor Goodwin J. Knight signed them into law July 8, 1955, to become operative July 1st, 1956.

Senate Bill 1555, the "Poultry Plant Sanitation Law," now Division 3, Chapter 3, Article 1 of the Agricultural Code, provides for an annual license fee of \$40 for poultry plants, and requires that poultry meat or its container be marked with the name and address of the poultry plant which slaughtered or processed the product. This act also provides for sanitary construction and sanitary operation of poultry plants, and for the approval of plans for intended construction or for major reconstruction. Appropriate penalties are provided for violation of the law or of regulations adopted thereunder. A grace period of six months subsequent to July 1st, 1956, is provided for compliance with regulations requiring alterations in plants or changes in equipment.

Exemptions Granted

Senate Bill 1633, now Division 3, Chapter 3, Article 2 of the Agricultural Code, as originally passed, provided for inspection and marking of poultry meat for wholesomeness. The law required all carcasses to be eviscerated under inspection, in order to determine freedom from evidence of diseases injurious to human health, as well as for the purpose of discovering pathological conditions or contamination which render meat not suitable for human food. This law also provides for training, examining and licensing of poultry meat inspectors. A fee of \$10 is required of meat inspectors who apply for a license as such. Important changes which were made at the 1956 Extraordinary Legislative Session are noted below.

Exemptions are granted in both the sanitation and the wholesomeness law for plants and processors operating under federal inspection or inspection by another state service approved by the director. Exemptions also are granted for plants in which poultry meat is slaughtered on the premises where produced, if sold by the producer at retail on such premises, or if sold by the producer to retailers or public eating establishments. An exemption pertaining to a "family producer" does not apply if the producer employs persons other than a member of his immediate family, and if the principal duties of the employee are concerned with the production of poultry.

Basic Poultry Laws Amended

Important changes were made in both laws at the 1956 Extraordinary Session of the Legislature through the enactment of Assembly Bill No. 29 (Chapter 22), introduced by Assemblyman R. H. McCollister, and approved by Governor Knight, April 12th, 1956. The act as approved exempts New York dressed poultry from the requirement that it be marked to show the name and address of the plant where slaughtered, and that the product has been inspected for wholesomeness. In effect, the bill permits marketing of poultry meat as New York dressed, that is, feathers removed and blood drawn. No evisceration is required thus precluding an internal inspection for wholesomeness. Exemptions provided in Assembly Bill No. 29 for New York dressed poultry expire November 1st, 1959.

BUREAU OF POULTRY INSPECTION

DIVISION OF ANIMAL INDUSTRY

SHOWING NEW BUREAU ORGANIZATION

STATE EMPLOYEES

CHIEF	1
ASSISTANT CHIEF	1
VETERINARIAN III (POULTRY HYGIENE)	2
VETERINARIAN II	3
VETERINARIAN I	17
SENIOR STENOGRAPHER-CLERK	1
INTERMEDIATE STENOGRAPHER-CLERK	1
INTERMEDIATE TYPIST-CLERK	1
POULTRY PLANT SANITATION INSPECTOR	10
POULTRY MEAT INSPECTOR	1300

* INDUSTRY EMPLOYEES

CHIEF
DIVISION OF ANIMAL INDUSTRY

CHIEF
BUREAU OF POULTRY INSPECTION

ASSISTANT CHIEF
BUREAU OF POULTRY INSPECTION

SENIOR STENOGRAPHER-CLERK
INTERMEDIATE STENOGRAPHER-CLERK
INTERMEDIATE TYPIST-CLERK

AREA SUPERVISOR
VETERINARIAN III
(SAN FRANCISCO)

ASSISTANT AREA
SUPERVISOR
VETERINARIAN II

VETERINARIAN I
5 POSITIONS ESTIMATED

POULTRY
PLANT SANITATION
INSPECTOR
3 POSITIONS ESTIMATED

POULTRY
MEAT INSPECTOR *
LICENSED
350 POSITIONS ESTIMATED

AREA SUPERVISOR FUNCTION TO BE
PERFORMED BY ASSISTANT CHIEF
(SACRAMENTO AND SAN JOAQUIN VALLEYS)

ASSISTANT AREA
SUPERVISOR
VETERINARIAN II

VETERINARIAN I
5 POSITIONS ESTIMATED

POULTRY
PLANT SANITATION
INSPECTOR
3 POSITIONS ESTIMATED

POULTRY
MEAT INSPECTOR *
LICENSED
350 POSITIONS ESTIMATED

AREA SUPERVISOR
VETERINARIAN III
(LOS ANGELES)

ASSISTANT AREA
SUPERVISOR
VETERINARIAN II

VETERINARIAN I
7 POSITIONS ESTIMATED

POULTRY
PLANT SANITATION
INSPECTOR
4 POSITIONS ESTIMATED

POULTRY
MEAT INSPECTOR *
LICENSED
600 POSITIONS ESTIMATED

New Bureau Created

Preliminary surveys indicated between 1,000 and 1,300 plants in California would be affected by the new laws. The organizational problem of bringing an entire industry of this size under jurisdiction of new laws were of such magnitude that the director, after considered study, decided that a specific bureau should be created within the Division of Animal Industry to handle the job. Accordingly, on October 5th, 1955, Governor Knight approved the request of the director to establish a Bureau of Poultry Inspection.

Fiscal Provisions

The California Legislature authorized \$13,993 for the 1955-56 Fiscal Year to finance preliminary organizational purposes. The budget included funds for employment of a bureau chief and a senior stenographer, purchase of supplies and equipment, development of regulations, forms, and a licensing system, as well as for training of poultry meat inspectors.

Budget allotments for total operation of the bureau during the fiscal year beginning July 1st, 1956, the effective date of the law, total \$287,864.

Organization of New Service

Surveys conducted by the department have provided the best information available on number and type of plants in each California county. Approximately 1,000 plants throughout California will be subject to the sanitation and wholesomeness laws. An arbitrary division of the State into three geographical areas indicates 266 plants are operating in the extreme northern counties, north coast counties and the San Francisco Bay area; 241 plants are in the Sacramento and northern San Joaquin Valleys, and Sierra-Nevada foothill counties; the remaining 482 plants are in the lower San Joaquin Valley and Southern California counties.

One supervising veterinarian and one assistant supervisor will be assigned to each of the three areas. These supervisory employees will be veterinarians experienced in poultry plant sanitation, diseases of poultry, and inspection procedures for wholesomeness. The two northern and Central Valley areas will have five veterinary inspectors working under each supervisor, and the southern area will have seven. The work of veterinary

personnel will consist principally of supervising and assisting state-licensed poultry meat inspectors.

In addition to veterinary personnel, 10 state-employed poultry plant sanitation inspectors will be assigned to conduct inspection of plants for sanitation, and to assist poultry inspectors and plant operators with sanitation problems. These inspectors will also work under supervision of area supervisors.

The total state-employed force will number 37, all under civil service. Plant operators will employ from 1,000 to 1,300 state-licensed poultry meat inspectors.

Proposed bureau organization is graphically illustrated in the accompanying chart.

Poultry Meat Inspection Schools

An unusual feature of the new law pertaining to inspection of poultry meat for wholesomeness is the provision for training, examining and licensing poultry meat inspectors who will inspect all poultry meat in state-inspected plants. Accordingly the director arranged for a training school May 31st to June 2nd, 1956, at the University of California in Riverside, and June 4th to June 6th, 1956, at the University Extension Center, 540 Powell Street, San Francisco. The schools were conducted by the University Extension, University of California, Berkeley. A tuition fee of \$10 was charged, and each student received a mimeographed brochure of the lectures.

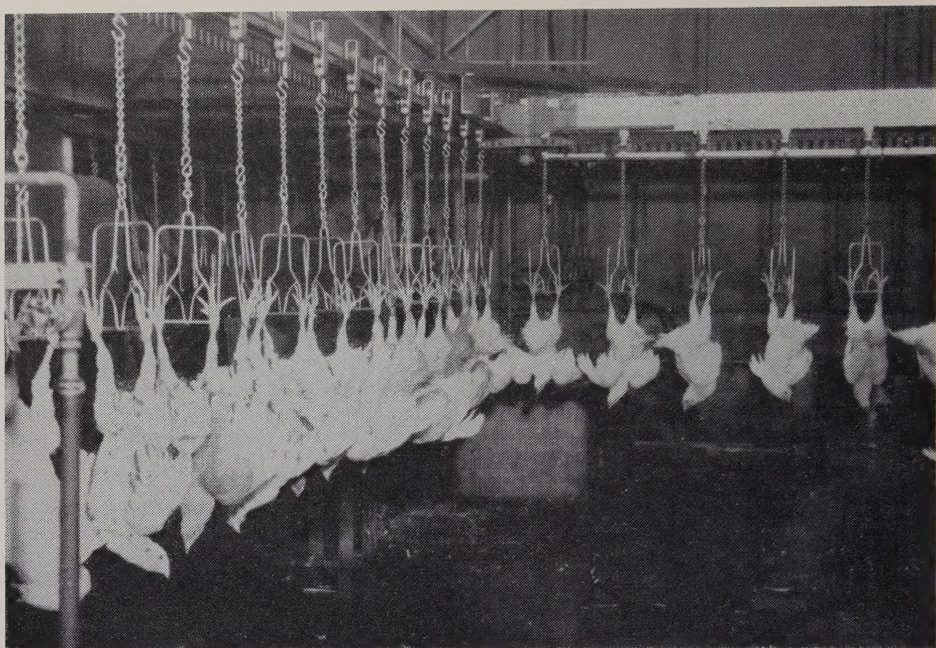
A team of four veterinarians from the California Department of Agriculture and the School of Veterinary Medicine, Davis, prepared the course of instruction, and arranged for 14 outstanding professional authorities to deliver lectures, many of which were illustrated with motion pictures and slides.

On the last day of each school, an opportunity to take a qualifying examination for licensing was offered to all.

Attendance at the schools, examination data and results are as follows:

Location	Attended school	Took examination
Riverside	382	330
San Francisco	450	357
Total	832	687

Fifteen failed to pass the examination. Most of those who attended the school were employees in poultry slaughtering plants; many were plant owners.



Continuous mechanical operation, beginning with live birds handled on shackles as shown above, reduces handling to a minimum and promotes sanitation

The Legislature did not provide for state financing of inspection, other than supervision; therefore it is the responsibility of plant operators to arrange for licensed poultry inspectors. It will be the principal duty of state-employed veterinarians to supervise these inspectors, and to make final decisions concerning acceptability of poultry meat retained by the licensed inspector for further inspection.

Regulations

The basic California poultry laws provide for sanitary standards and inspection for wholesomeness procedures to be established by regulations. Shortly after the legislation was enacted, therefore, tentative regulations for study purposes were drafted by Dr. Ray McFarland, Assistant Chief, California Bureau of Meat Inspection. The Poultry Inspection Division, United States Agricultural Marketing Service, and the United States Public Health Service graciously supplied the Division of Animal Industry with much standard regulatory material. From this and other material, tentative poultry inspection regulations were prepared. An attempt was made to follow regulations of the

United States Agricultural Marketing Service.

The proposed regulations were first submitted to the California poultry industry for study on January 19th, 1956. The regulations were subsequently redrafted several times, incorporating considerations raised at approximately 50 industry meetings held throughout the State. General understanding finally was reached on regulations which complied with legal requirements, and which the industry considered workable.

In accordance with the California Administrative Procedure Act, public hearings were held April 30th, 1956, in Los Angeles, and May 8th, 1956, in Sacramento, for the purpose of considering the proposed regulations. The regulations were approved May 25th, 1956, to become effective on July 1st, 1956; on filing with the Secretary of State, they became a part of the California Administrative Code.

Features of the New Inspection Systems

The California poultry inspection laws:

1. Provide the only state-wide systems of compulsory poultry plant sanitation and



Birds suspended in the air by shackles during the evisceration operation pictured here are kept from surface contamination

poultry meat inspection for wholesomeness in the Nation;

2. Exempt from provisions of the law all poultry plants operated under federal inspection and poultry meat inspected for wholesomeness by the United States Department of Agriculture;

3. Exempt poultry processed by the grower when the operation is essentially a family enterprise;

4. Recognize state, county and city poultry inspection services outside California, provided that their requirements meet the approval of the Director of Agriculture;

5. Provide for schooling and examining prior to licensing of poultry meat inspectors, who may be plant owners or plant employees;

6. Exempt New York dressed poultry for a period of approximately three years;

7. Include, within the scope of inspection, rabbits and all domesticated birds to be used for human food;

8. Provide six-month grace period prior to compliance with department notice to effect plant alterations or changes in equipment;

9. Require that the Director of Agriculture approve plans for intended construction or major reconstruction of a poultry plant;

10. Include injunctive relief, in cases of noncompliance with the law or regulations adopted thereunder, as well as a misdemeanor clause for violations, with a penalty of \$500 provided;

11. Provide for revocation or suspension of the license of a poultry meat inspector, in the event of incompetence or malfeasance.

The Future of Poultry Inspection in California

The success of this new service will depend largely upon the effectiveness and ability of inspection personnel, and industry cooperation.

Techniques of operation and plant facilities are also important factors for success. Methods and equipment used in processing and marketing poultry meat are continually being improved; unprecedented changes are being introduced at an accelerated rate not experienced by any other related food industry. In view of desirable changes and improvements now appearing in poultry processing facilities, operators must consider this development when planning new equipment and buildings.

Preliminary inspections indicated that most California poultry processors have not kept abreast of improvements in methods and equipment; observation and objective surveys now substantiate the view that they need help. Department of Agriculture policy intends to be firm in enforcement, but also to serve the processor by an educational program in conjunction with enforcement. If the industry cooperates, and present indications are that it will, much progress can be made, not only in fulfilling the intent of the laws, but also in expanding and modernizing the service which the industry offers to California consumers of poultry products.

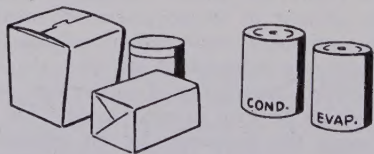
Building Sales for California Dairy Products

By C. VERNON HANSEN, Chairman
California Dairy Industry Advisory Board

The California Dairy Industry Advisory Board celebrates its 11th year of service to milk producers, processors and distributors of the State during 1956. Through its successful promotion in behalf of 4,000 grade A milk producers, 20,000 manufacturing milk producers, and 1,000 processors and distributors of milk and dairy products, the board has established a record to which all California dairymen may point with pride.

The board is responsible for a diversified program. Its activities are designed to increase the consumption of milk and dairy products in California and to promote and foster a better understanding of the important role that the industry occupies in the economy of the State, and its vital contributions to the health and welfare of its citizens by providing an adequate supply of pure and wholesome milk and dairy products.

The board is made up of 25 members from all locations in California, and who represent all segments of California's giant dairy industry. Members serve without salary and are reimbursed only for their expenses incurred in meetings of the Advisory Board and of the particular committee within the board to which they are appointed by the executive committee. The board itself is ap-



pointed by the Director of Agriculture who makes annual appointments of one-third of the membership on the basis of nominations received from each component of the industry. Term of office for members is established by the Advisory Board Act which also specifies procedures for holding nomination meetings in 10 regions of the State each fall. In keeping with the legislative enactment, programs of "institutional," or non-brand name advertising, research, education,



CALIFORNIA DAIRY INDUSTRY ADVISORY BOARD

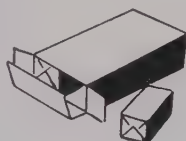
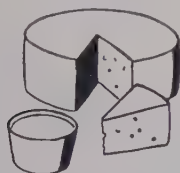
and general public relations are formulated by the board and are carried out by its staff located in Sacramento, San Francisco, Fresno, Los Angeles and San Diego.

The board's annual budget is approximately \$500,000, a fund raised through assessments paid by milk producers and handlers. The assessment paid by each group is 5 mills per pound of milk fat on all production and distribution of milk fat during the months of October and May of each year.

Educational Program

Many dairymen regard the board's educational work as the heart of the total program. There is much evidence to support the belief that such work plays a very important part in the establishment of long-term "markets" for milk and dairy foods. Food habits of both child and parent are directly influenced by the educational program which the board sponsors in public and private schools within California. The staff of the board cooperates effectively with the teaching profession, and engages in other activities which are amplified many fold through the assistance of key leaders in other professional fields. These leaders include such people as curriculum directors, school nurses, school physicians and dentists, and public health workers. Although these professional people already have a good understanding of the important part dairy

products play in the daily diet, they depend upon the advisory board for assistance with health education materials and current information about nutritional values of dairy foods. The acceptance of the board's position with the schools was recently summed up by Mrs. Edith Harwood, Director, Home Economics Department, San Diego City Schools, who, incidentally, is President of the California Home Economics Association and a nationally known authority on nutrition. Mrs. Harwood said, "The health and educational materials provided to schools by the California Dairy Industry Advisory Board are highly acceptable to them, because they are developed with the cooperation and aid of leading educators and are appropriately designed for the age and grade levels where they will be used. Further, they are 'institutional' in nature and do not present problems in use which would be encountered with materials bearing brand identification. The advisory board has established a reputation for accuracy and au-



thenticity in its materials, thereby enabling teachers to do more intensive training of their students in sound nutrition than they can do with regular classroom materials alone."

Further positive evidence of the influence of the board with the school systems of the State has been demonstrated in the operation of the Special Milk Program. California's development of this program has been so effective that the original federal appropriation of \$2,600,000 for California's 1955-56 school year had to be increased to more than \$4,000,000. Sales to students increased 76 percent over the previous school year while cash value to the California dairy industry increased from \$8,000,000 to \$14,000,000. In commenting upon California's Special School Milk Program, Martin D. Garber, Director of Food Distribution Division, Agricultural Marketing Service, United States Department of Agriculture, said: "For all the Nation California has the largest number of schools participating in the special school milk program. This outstanding achievement is the result primarily of the close

cooperation of local school districts, the California Department of Education, the California Dairy Industry Advisory Board, and the United States Department of Agriculture."

Research Program

A continuous research program has been carried on by the Dairy Industry Advisory Board since its inception. Projects have been and are now being carried on by the University of California at the Davis campus, with the Home Economics Department in Berkeley, and at the School of Medicine of the University of Southern California. All research projects undertaken and authorized by the board have one ultimate purpose, namely: to increase the sales of milk and dairy products. The board's research program falls into four broad classifications: (1) seeking to improve the quality of California's milk and dairy products; (2) development of new and increased uses for milk and dairy products; (3) scientific support dem-

onstrating the superiority of dairy products; (4) seeking improvement in the effectiveness of our merchandising efforts.

Studies have been carried on which have materially assisted quality control of a wide array of products such as evaporated milk, powdered milk, ice cream, whole milk, and cottage cheese. A more detailed research report is available upon request to the board.

Advertising Program

The advisory board carries on a consistent, continuous institutional advertising program. It is designed to "condition the market" for dairy foods and provide a base upon which individual processors and distributors can build their sales of brand-identified milk products. The board's advertising is slanted to mass consumer appeal, using attractive artwork and phrasing which capture the attention of all age groups.

Slogans developed in connection with the board's advertising campaigns have become national favorites for promoting dairy product sales. Best known of these is "Make Mine Milk," which has been used effectively

on automobile bumper strips, outdoor billboards, and in newspaper and television ads. Other popular phrases created in California are "No Other Food Gives You So Much for So Little"; "Enjoy the Drink of Good Health—Milk!"; "When It's Time for Refreshment—Remember Your Health—Enjoy Milk for Life"; and "For health, taste and economy . . . use dairy foods."

Such slogans, together with the complete copy contained in the body of newspaper, radio and television advertising, stress the importance of the four basic satisfactions derived from using dairy foods in the daily diet—their good taste, their refreshment qualities, their economy, and the great contribution they make to good health. To a considerable extent the board's advertising is integrated with its educational work, serving to remind consumers of the sound nutritional information provided for them through the board's broad educational services.

materials depicting their dairy products in appetite-appealing combination with other California foods. Posters and banners are integrated in color and design with the general promotional materials supplied by the June Dairy Month national organization; furthermore, all promotional materials are coordinated with the brand-identified pieces designed by individual California processors.

The Dairy Industry Advisory Board balances its advertising, utilizing a variety of media—newspapers, radio, television, and outdoor billboards. Specific annual campaigns use the type of advertising which has been proved to be the most effective use of available advertising funds. Since the total budget is divided among research, education, publicity and advertising activities, not all advertising media may be used in a particular annual campaign. But an effective program is always developed, and national recognition has been achieved on many oc-

Enjoy Milk, the drink of Good Health!



The board's institutional advertising is integrated with its educational work serving to remind consumers of nutritional benefits of drinking milk

As with other phases of its total program, the board develops its advertising campaigns on the basis of recommendations of its own advertising committee along with the professional counsel of the advertising agency it employs. The committee gives representation to all segments of the industry and formulates its plans after conferences with advertising specialists from distributors throughout California. A well-rounded program is then coordinated with local, statewide, and national advertising efforts.

Development of point-of-sale materials for June Dairy Month use is a good example of such coordination. California dairymen prefer that the advisory board create specialized

casions. The 1955-56 newspaper campaign, for example, was so successful that it was adopted nationally and in Canada by the Milk Industry Foundation, a national distributors' organization. Through its advertising program, therefore, the Dairy Industry Advisory Board has an effective tool for successful performance of its basic job of increasing the consumption of California milk products.

Public Relations Program

It has been noted above that the Dairy Industry Advisory Board works to increase the consumption of California dairy products and to promote better public understanding



California Dairy Industry Advisory Board point-of-sale posters publicizing June Dairy Month

of the industry and its important part in the over-all economy of the State. Long-term basic consumer understanding and goodwill are developed through the regular educational activities of the board.

But there is need for activities which influence the great number of people who are not in regular contact with schools or other agencies carrying on formal educational programs. Specialized activities which fall within the field of "public information" or "public relations" are the most effective means of creating, in a large percentage of the total population, an awareness of the board's message.

There are several major types of activity carried on regularly as a part of this "public relations" phase of the total Advisory Board program. Included are informational campaigns in association with important public communications media: newspapers, radio and television; participation in local and regional fairs and exhibits; programs for community organizations such as service clubs and trade or agricultural associations; and state-wide seasonal promotions such as "June Dairy Month."

The Advisory Board provides a continuing supply of information and assistance to

editors of newspaper food pages and directors of food "shows" on radio and television, which all receive a high percentage of consumer attention. Frequently, board staff members appear personally as program guests or as "guest editors" for leading food columns. Similar cooperation is enjoyed with agricultural editors and program directors. Thousands of recipe books showing the uses of dairy foods have been distributed by the Advisory Board through the cooperative work done with communications people.

From its inception the board has presented, at the State Fair and the Los Angeles County Fair, annual exhibits and programs intended to give a better understanding of the tremendous work being done by California's dairy producers and distributors in creating an adequate supply of health-giving, delicious dairy products. Recently the board expanded its exhibit services, adding several traveling displays which are loaned to local dairy groups for use at county and district fairs.

The importance of milk products in the diet of adults and the influence of the dairy industry on the local economy are brought to the public's attention through staff appearances before service clubs and other local organizations. Informative films and



An example of special promotional material used in cooperation with the California Cling Peach Advisory Board

filmstrips are supplied for meetings when staff participation cannot be arranged.

Joining with the dairy industry throughout the Nation, the California Dairy Industry Advisory Board coordinates the annual California observance of June Dairy Month. Special materials for food market, restaurant, and store window displays are distributed, and county committees which plan local functions to stimulate renewed public interest in dairy foods during the month are organized. Other special promotional events are carried on in cooperation with food groups concerned, such as the Cling Peach Advisory Board or the Turkey Promotion Advisory Board, which also help expand the opportunities for "selling" dairy products.

The Dairy Industry Advisory Board maintains a flexible public relations program, adapting itself to new opportunities as they present themselves for telling a pertinent and effective dairy products story. The board's activities are broad enough to augment effectively the efforts of the individual dairyman or local distributor, yet close enough to the local California level to be responsive to and satisfactorily meet the specialized needs of the dairy industry within the State.

Milk Consumption Increased

What have been the results of this long-range program of education, research, advertising and publicity, and what has such a program meant to California's producers, manufacturers, and distributors? At the July, 1956, meeting of the Dairy Board, the California Department of Agriculture reported a 42 percent increase in *per capita* consumption of fluid milk by Californians during 1955, compared with the five-year average for 1935-39. A like comparison also shows the State's population increased 101 percent, and fluid milk sales increased 185 percent. Although no one associated with the Advisory Board takes the position that this outstanding increase in milk usage can be attributed solely to the board's efforts, there is no doubt that such promotional and educational activities have played a fundamental role in achieving these results. And it is not only in fluid milk consumption that results are shown. During the last five years substantial sales increases for many other dairy products have occurred—nonfat milk sales are up 22 percent; chocolate drink has risen 27 percent; sour cream 79 percent; ice cream 16 percent; cottage cheese 29 percent; whole milk cheese 52 percent; whipped cream topping 149 percent; and buttermilk 68 percent.

The Dairy Industry Advisory Board serves both the dairy industry and the public. Improving the utilization of dairy foods is good for the industry, but at the same time it is building and maintaining stronger and healthier bodies for California consumers. The board constantly works toward nutritional goals set by impartial nutritionists, who say that Californians need to increase their use of milk and its products at least 20 percent, for their health's sake. With this as a goal, the Advisory Board continues to urge Californians to consume daily at least three glasses of milk or the equivalent in other dairy foods.

The 10 years of service already rendered to the industry by its Dairy Industry Advisory Board are only the beginning of the work that is yet to be accomplished. With a sound program which provides for democratic representation of the industry within the membership of the board itself, a proven flexibility of program and services and the "know-how" to do the job effectively, we cannot fail to continue building sales for California milk and dairy products.

Camelthorn—New Approaches to Eradication

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Although camelthorn, *Alhagi camelorum*, Fisch., has been established and widely scattered in California for many years, the finding of it in San Bernardino County during 1951 by Mary Beal, a local botanist, came as a distinct surprise. The most recent discovery is an infestation comprising 183 acres along the Mojave River in Afton Canyon, a remote desert area about 45 miles east of Barstow. Except for the mainline of a trans-continental railroad, the area is not readily accessible; however, it can be traversed by four-wheel drive vehicles. Infrequent visitors to Afton Canyon include prospectors, sightseers and occasionally by chance persons interested in desert flora. From the standpoint of forage, the surrounding arid desert is of little value, but the year-around flow of water in the Mojave River is valuable for livestock grazing. On the other hand, surface and subsurface water also provide moisture for camelthorn.

Discovery of camelthorn in Afton Canyon was followed during 1952 by another at Barstow, where a small infestation was found south of the city limits and west of U. S. Highway 66 near an abandoned railroad right-of-way. In October, 1954, a third major infestation comprising 10 acres was discovered on abandoned farm land near an old well site in the Hinkley district nine miles west of Barstow. Although difficult to trace the origin of camelthorn in Afton Canyon, it is easy to surmise how the infestation in the Barstow area originated, particularly on the abandoned farm land at Hinkley. Evidently the history of this infestation dates back to World War I when alfalfa was planted on this property, for it is known that "Camelthorn gained entrance into California in two ways: (1) in early shipments of Turkestan alfalfa seed, and (2) in the packing around date offshoots. The former

is undoubtedly the chief source."¹ It is interesting to note that the Hinkley infestation, apparently one of long standing, has not spread even though livestock including both cattle and sheep have grazed across the property many times. Non-occurrence of camelthorn outside the area probably can be ascribed to the dry desert conditions that prevail.

Camelthorn, an Aggressive Invader

Camelthorn attracted attention in California early in the decade of the 1920's when this perennial weed was discovered on cultivated lands in the Imperial and Coachella valleys. The aggressive nature of the invader compelled attention because of its great ability to spread.

To understand fully the problem involved in controlling camelthorn, one should become acquainted with the plant's root system. In the book, *Weeds of California*,² an apt description is provided: "Camelthorn has a well-developed root system which often extends to a depth of six or seven feet. There is a tendency for the rootstocks to branch at the three to four and one-half foot level, and from these branches aerial stems arise. The rootstock system of camelthorn may be very extensive, spreading in all directions from a mother plant to a distance of 25 feet or more." Furthermore, to control camelthorn one must be able to recognize and identify the plant. "Camelthorn is a somewhat woody bush one to three feet tall. The stems are armed with thorns. Leaves simple, petioled, entire and smooth, varying in size from very small ones at top of plant to those three-fourths inch long lower down. Flowers are maroon. The fruit is a slender pod, twisted in various forms, and pinched

1. ² W. W. Robbins, Margaret K. Bellue, and Walter S. Ball, 1951 edition, *Weeds of California*, p. 253.

in here and there so as to appear like a string of beads. Usually a small spine occurs at the end of each pod. The seeds resemble large clover seeds, yellowish—or greenish-brown with dark mottling, to dark brown. Camelthorn blooms in June and matures pods in July.” The authors point out that the plant is relished by camels, horses and cattle in its native land and that “Browsing animals have been a factor in disseminating camelthorn in the State. On the dry lands of Kern County, in the areas infested with the weed, one may find large numbers of seed in the droppings of both horses and cattle. Tests show this seed to be viable.”³

History of Early Control in California

The first attempt to control camelthorn in California was made in Riverside County, beginning during the fall of 1923; the technique of deep plowing at repeated intervals was tried in order to prevent top growth. The futility of this method was indicated when that county reported in 1926 expenditures for the program had totaled \$16,000 for one 80-acre tract. During the same year, control by flooding was reported from Imperial County. In 1927 Riverside County was successful in controlling camelthorn with carbon bisulphide as a soil sterilant, and in 1928 the county explored the use of arsenicals; however, by 1929 a total of \$27,624 had been spent for cultivation and the use of carbon bisulphide. It was this situation which led to the enactment of Section 159 of the Agricultural Code declaring camelthorn a public nuisance and providing that “The director shall eradicate camelthorn wherever the same exists in this State. The expense thereof shall be borne one-third by the State, to be paid out of any sum appropriated for such purpose, one-third by the county in which the land is located on which such camelthorn exists, and one-third by the owner of such land. * * *

By 1932 camelthorn had been found in seven counties of the State, and the only generally effective method of control was the use of carbon bisulphide, which cost from \$185 to \$225 per acre. Because of such high costs, a more economical method was sought, resulting in development of the sodium arsenite jar method by Walter S. Ball and W. W. Robbins. In 1935 the jar method was reported very satisfactory and much

cheaper than control with carbon bisulphide, the cost averaging about \$25 per acre. Even with the advent of new chemicals such as 2,4-D, the jar method still plays an important role in camelthorn control.

Recent Departures in Control

Prior to 1952 it was felt that in order to eradicate camelthorn successfully, the infested areas should not be disturbed by farming operations. The general practice was either to fence those infestations occurring in cultivated areas and farm around the isolated spots while they were being treated, or return infested farm lands to dry land pastures and attempt control.

The trend in California agriculture in the last decade has been toward expansion of irrigated crops, especially cotton in the San Joaquin Valley. This development, consequently, has created a greater demand for land, and any idle arable land that could be irrigated and successfully farmed was valuable for production. From this situation a new departure in camelthorn control developed: treating established infestations in row crops. The new venture was initiated with some uncertainty, because: (1) the old established plants would be difficult to locate and treat in the midst of growing crops; and (2) land leveling operations would undoubtedly spread seed and roots a considerable distance thus increasing the potentiality for new growth.

Fortunately the new program unexpectedly has made camelthorn control operations more simple and satisfactory. Results are particularly encouraging in Kern County, where several sections of land had a long history of camelthorn. In this particular case the acreage was leveled and planted to cotton. Normal weed control operations as practiced in row crops have greatly reduced the seedling population of camelthorn in the infested areas. Furthermore, periodic irrigation of the fields has made possible the treatment of old camelthorn plants with carbon bisulphide repeatedly throughout the year; dependence upon rainfall to provide the correct amount of moisture was eliminated. Stimulated plant growth also has made possible more frequent treatment by the sodium arsenite jar method. This new program is also in effect in Riverside and Imperial Counties.

³ Ibid.



After two years of control operations, including six treatments by aircraft in this remote canyon of San Bernardino County, it is estimated that control results are 95 percent based upon regrowth observed prior to the sixth treatment

Plot Trials in Afton Canyon

The presence of camelthorn at Afton Canyon in San Bernardino County presented a new situation and a difficult problem because of the rough terrain, remoteness of the infestation from human habitation and the large acreage involved. From the standpoint of expense and the availability of labor, it was readily apparent that the sodium arsenite jar method and control by soil sterilization with carbon bisulphide would be impracticable, except possibly in later stages of the project and then only under controlled conditions. The most practical tool at hand seemed to be 2,4-D or other hormone-type herbicides, although results from the use of these materials on camelthorn had been variable. If effective, 2,4-D would be safe to use and economical insofar as material and application costs are concerned. Therefore, test plots were set up in Afton Canyon May, 1951, in order to explore the use of 2,4-D and other materials.

A dense, vigorous and uniform infestation of camelthorn on a gravelly and saline soil in an overflow area of the Mojave River was selected for the test location; during the first week of May, 1951, seven series of trials were begun. Primarily, trials included foliage treatments with various forms of 2,4-D

and 2,4,5-T at dosage rates from two to six pounds of acid equivalent per acre at the volume rate of 80 gallons of water solution. Several treatments included the jar method with the amine form of 2,4-D (a solution of 1/10 of 1 percent based on acid equivalent) and also sodium chlorate (1 and 2 percent solutions).

A high degree of top kill resulted from the treatments, except in the case of the jar method. Results of the jar treatments were for the most part negative. The camelthorn rapidly recovered in spite of the fact that foliage applications appeared effective. Excavation of treated plants revealed the emergence of new shoots from laterals and crowns. It was readily apparent that the plants were making a good recovery, although growth had been depressed and portions of the roots destroyed. An analysis of the results indicated that if any appreciable headway was to be made in the control of camelthorn with hormone-type weed killers, the regrowth must be treated during the current growing season.

A New Approach to Eradication

In early May, 1952, the multiple treatment procedure was begun, which fortunately proved to be a very far-reaching departure.

The new schedule included the following formulations: (1) the butoxy ethanol ester of 2,4-D; (2) the propylene glycol butyl ether ester of 2,4-D; (3) the butoxy ethanol esters of 2,4-D and 2,4,5-T combined (brushkiller); (4) the emulsive acids of 2,4-D and 2,4,5-T separately; and (5) the alkanolamine salt of 2,4-D. Application was made by power equipment and hand equipment for retreatments.

Employing the multiple treatment procedure, it was found necessary to make three treatments per growing season, which included applications in the spring, midsummer and fall. During 1952 and 1953, the most promising trial plots were treated a total of six times. As the treatments progressed during the second year of the multiple treatment procedure, the decline in plant population of the most promising plots was quite impressive, control in many instances ranging from 95 to nearly 100 percent. The trials revealed, among other things, that the relatively high rate of four pounds of acid equivalent per acre was required for the control of camelthorn in Afton Canyon. Interestingly enough, several materials proved quite effective, including the low-volatile esters of 2,4-D and 2,4,5-T and the emulsive acid of 2,4-D. In view of the results with the several compounds, the choice of material was primarily a matter of cost. From this standpoint, it was recommended that the low-volatile ester of 2,4-D be used.

Control in San Bernardino County

Control operations in Afton Canyon got under way in May, 1954. The low volatile ester of 2,4-D at the rate of four pounds of acid equivalent in ten gallons of water

per acre was applied by airplane, and three treatments per growing season were made, as in the test plots. A conservative estimate of control results was 95 percent based on re-growth observed prior to the sixth treatment in the fall of 1955. Interesting was the lack of seedling growth now evident after two years of control. Each application was made according to pre-arranged schedule. Spring treatments during 1954 and 1955 were made when camelthorn plants were beginning to bloom. Midsummer and fall treatments were made in corresponding growth periods.

After completion of control operations during a two-year period, including six treatments by aircraft in Afton Canyon, three treatments at Hinkley and six treatments by ground equipment in areas not accessible to aircraft, the average cost per treatment was \$8.25 per acre. This is a very conservative figure in view of the difficult operation and the required high dosage rate of 2,4-D which alone accounted for 60 percent of the cost. The activities of cooperating agencies and others concerned with the project have been well coordinated, and the results portend well for the future.

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Camelthorn, *Alhagi camelorum*



PLATE I. Mal secco infection, young lemon tree. Note affected twigs without leaves lower right of tree.

Mal Secco Disease of Citrus

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Mal secco, a fungus disease of citrus, is important in certain citrus-growing areas of the islands and coast of the Mediterranean Sea. Although the disease is not known to occur in California, if it becomes established here, much damage to lemon plantings can result. California varieties, when tested in Sicily, were found to be susceptible to this disease (Ruggieri, 1948; Goidanich and Ruggieri, 1947).

An area of 12,000 to 15,000 acres of citrus, principally lemon trees of the choice Femminello variety, has been destroyed in Sicily and the Italian Region of Calabria. Although the disease is still of considerable importance in these regions, growers have learned to cope with it (see Control) and have replanted the devastated areas with the sus-

ceptible Femminello variety. During the epiphytotic periods of the disease, the resistant Monachello variety was used for replanting. However, since this variety produces fruit only during the fall and early winter and is inferior to Femminello in yield and quality of fruit (quantity and acidity of juice and quantity of oil), it is being top-worked to Femminello.

According to Baldacci and Garafalo (1948), the mal secco disease of citrus was first recognized on the Greek island of Chios in 1894. Plantings on other Greek islands and in neighboring Cyprus and Palestine are now also affected. The disease may have been present in Turkey at an earlier date. Since it has not been found in India, China, or Japan, it probably originated in one of



PLATE II. Bad drying of citrus. (After L. Petri.) (Translation from Petri with editorial notes bracketed.)

FIG. 1. Portion of a twig attacked by bacteriosis (citrus blast) produced by *Phytophthora citripetale* C. O. Smith [now considered to be *Pseudomonas syringae*]. FIG. 2. Terminal portion of a twig of bitter orange attacked by mal secco in the first stage of infection. Abscission of the leaves at the point of attachment with the petiole which is still attached to the twig. D. fibrovascular bundles reddened by the presence in them of the mycelium of *Deuterophoma* penetrated from the leaves. FIG. 3. Portion of a lemon twig attacked by bacteriosis and to which adheres the dead leaf which was the avenue of infection. FIG. 4. Same as Fig. 3, appearance of the necrosis when the cortical tissues are impregnated with gum. FIG. 5. Same as Fig. 3. FIG. 6. Twig of bitter orange killed by tracheomycosis [mal secco] without the attack of *Colletotrichum* [a facultative parasite that often follows infection by *Deuterophoma*]. The lead gray spots (D) are caused by the formation of pycnidia of *Deuterophoma* under the epidermis. In D' the epidermis has been removed to show the pycnidia. FIG. 7. Portion of a twig of bitter orange in longitudinal section at the point of attachment of a leaf petiole showing the red-orange colored fibrovascular bundles (D) which came from the infected leaf where the infection was initiated (slightly enlarged). FIG. 8. Twig of bitter orange attacked by tracheomycosis [mal secco] followed by anthracnose caused by *Colletotrichum gloeosporioides* whose acervuli can be seen (C). At D are the typical lead gray spots produced by the lifting of the epidermis by pycnidia of *Deuterophoma tracheiphila*. FIG. 9. Twig of bitter orange attacked by tracheomycosis [mal secco] in which can be observed at D the characteristic coloration of the wood; anthracnose produced by *Colletotrichum* has caused the darkening of a large part of the cortical tissue.

the areas on the eastern end of the Mediterranean basin. It appeared in the important citrus areas on the island of Sicily in 1918, and was found near the Sicilian cities of Catania in 1922 and Palermo in 1938. Then it spread to the Italian mainland through Calabria, reaching Latina Province in 1947. It has not yet been found in Egypt and other North African citrus areas or Spain, and presumably orchards of South Africa and the Western Hemisphere are still free.

The first apparent external symptom of the disease appears in the leaves. They become dull in sheen and color and usually drop; or, if the onset is very sudden and rapid, the leaves may dry in place on the tree. On diseased trees, new leaves of the spring or fall growth are chlorotic instead of the normal red changing to green. The wood, when invaded by the pigment-forming and more virulent strains of the causal fungus, *Deuterophoma tracheiphila*, is at first salmon pink to orange in color then changes in succession to rusty orange, brown, and black. The less virulent non-pigment-forming strains of the organism cause a browning of the wood. Twigs, branches, and entire trees wither and die if affected parts are not removed by pruning (Plates I and II). Following death of the woody tissues, the fungus invades the bark where lead gray areas develop (Plate II, Figs. 6 and 8). Removal of the epidermis in these areas reveals flask-shaped spore-bearing structures (pycnidia) of the causal fungus (Plate II, Fig. 6D'). These exude spores (Plate III, M) which are distributed by windblown rain to infect other trees. Infection of trees by the mal secco fungus is frequently followed by a secondary fungus, *Colletotrichum gloeosporioides*, which causes the disease called anthracnose (Plate II, Fig. 8C). This fungus produces, in the unremoved epidermis of the diseased twigs, cup-shaped spore-bearing bodies (acervuli) which can be seen with the unaided eye. Plate II, Figs. 1, 3, 4, and 5, shows the symptoms of citrus blast, a bacterial disease caused by *Pseudomonas syringae*, which may also be found associated with mal secco. Both anthracnose and blast occur in California.

The causal fungus, described and named *Deuterophoma tracheiphila* by Petri, belongs in the Phomaceae, a family of Fungi Imperfecti which produces its spores in brown or black pycnidia (Plate III). The small, bacterium-like spores are also formed endogenously in flask-like structures on the my-

celium (Plate III). The mycelium grows and fruits in the wood vessels. Since the disease progresses more rapidly from the root upward into the trunk and branches than in the reverse direction, the invasion is apparently favored by the transpiration stream. The fungus is readily isolated from all parts of the tree, including roots, trunk, branches, twigs, leaves, thorns, and fruits of all stages of maturity taken directly from the tree.

Low concentrations of copper sprays, captan, zineb, Hyamine, nabam, malachite green, and 8-hydroxyquinoline benzoate Lo 738 prevented germination of the spores, but these chemicals were ineffective as prophylactics or therapeutics when applied to soil in which sour orange seedlings were growing. Solutions of malachite green injected by high pressure into the wood of an infected tree killed the fungus wherever the dye penetrated. If such injection were easy to accomplish, it might be used as a substitute for pruning and surgery in the treatment of affected trees. Growers, however, have become very adept in detecting the early stages of the disease, and by cutting beyond the advancing margin of the diseased areas, they can keep lemon trees in a profitable state of production for many years. It is only when severe weather conditions favor mass inoculation of the trees that the disease gets out of hand. Hail injury, accompanied or followed by wind-driven rain, provides a condition favorable for infection. Professor Ruggieri, Director of the Citrus Experiment Station at Acireale, Sicily, has demonstrated that 1 percent solution of copper oxychloride sprayed on trees once every 15 days, during October, November, December and January, provided good protection. By repeated application of a heavy spore-mycelium suspension of the parasite to the soil of potted sour orange seedlings, he also showed that uninjured roots of this very susceptible variety are probably not infectable. Accordingly, the practice of scraping away the soil from the upper roots to hasten drying, as used in the Verdelli method to promote production of summer fruit, has been largely discontinued because of root injury and a high incidence of a rapidly fatal form of mal secco following such practice. Now, water is simply withheld 40-60 days during June and July until the trees wilt. Then they are fertilized and basin flooded two times one week apart, followed by basin flooding every 10 to 14 days until the rainy season. This procedure

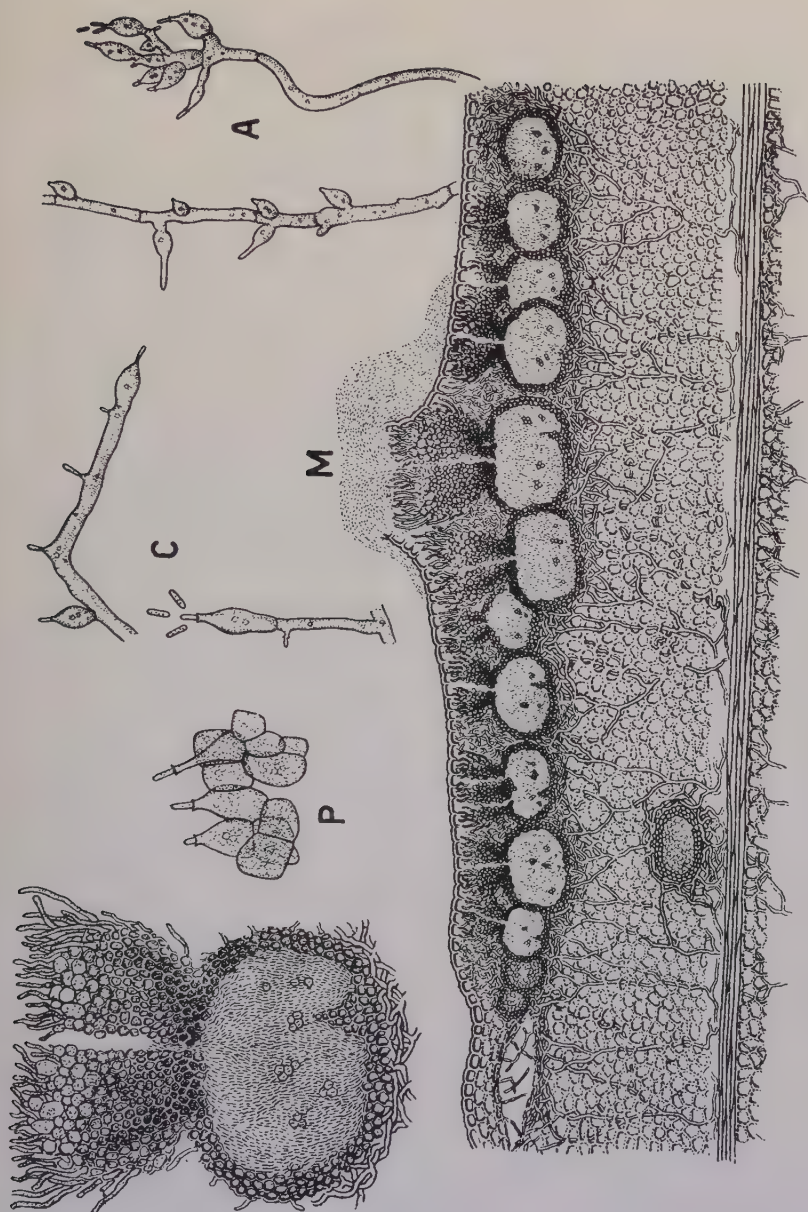


PLATE III. Microscopic morphology of *Deuterophoma tracheiphila* Petri. (After Goidanich and Ruggieri, 1947.)

TOP, LEFT—Details of mature, flask-shaped, spore bearing structure (pycnidium) and, in larger magnification, the fertile cells (P) of the pycnidial lumen from which are differentiated the pycnidiospores. TOP CENTER—Fertile hyphae with phialoform conidiophores in diverse stages of differentiation (C). TOP, RIGHT—Fertile hyphae with phialoform-like conidiophores (A). BOTTOM—A number of fruiting pycnidia seen in a radial section of a two-year-old twig attacked by mal secco. Note the many flask-shaped, spore bearing structures (pycnidia), their internal, spore producing cells, and their hyperplastic necks which have distended and broken the epidermis permitting the exit of masses of mucous and spores (M).

stimulates the blooming which produces fruit the following summer. By this modification of the practice, the trees largely escape the fatal mal secco infection of the roots, yet produce the profitable summer crop of lemons.

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Successful Eradication of Mexican Bean Beetle in California

By H. M. ARMITAGE¹

Culminating nine and one-half years of intensive operations initiated during July, 1946, the eradication of all known California infestations of the Mexican bean beetle, *Ephialachna varivestis*, has been successfully accomplished. Since 1946 the beetle had been restricted to Ventura County.

All evidence indicating eradication is supported by the fact that following a carefully planned and well-executed treatment program, no survivors have been found during more than six years which have elapsed since the last finding on July 27th, 1950. The life history of the beetle is such that it would have increased in sufficient numbers during that time to be readily detectable by the intensive inspection measures carried out in conjunction with eradication measures.

This accomplishment is of major importance to the growers of both fresh and dry beans throughout the State. Beans are a major California crop, averaging 300,000 acres annually; bean marketing returned \$54,494,000 to growers during 1954. *Epilachna varivestis* is rated the number one pest of beans throughout Eastern United States, where it is widely distributed and often responsible for total crop loss. Once permanently established, it is both difficult and expensive to control.

Finding of the beetle in California on July 22nd, 1946, therefore, caused considerable concern to growers, particularly since the initial infestation lay in the heart of a large contiguous area devoted to production of high value lima beans. The 1946 finding marked the first recorded Mexican bean beetle occurrence in any Pacific Coast state. Prior to 1946 it had been known west of the Continental Divide only in Utah and New Mexico.

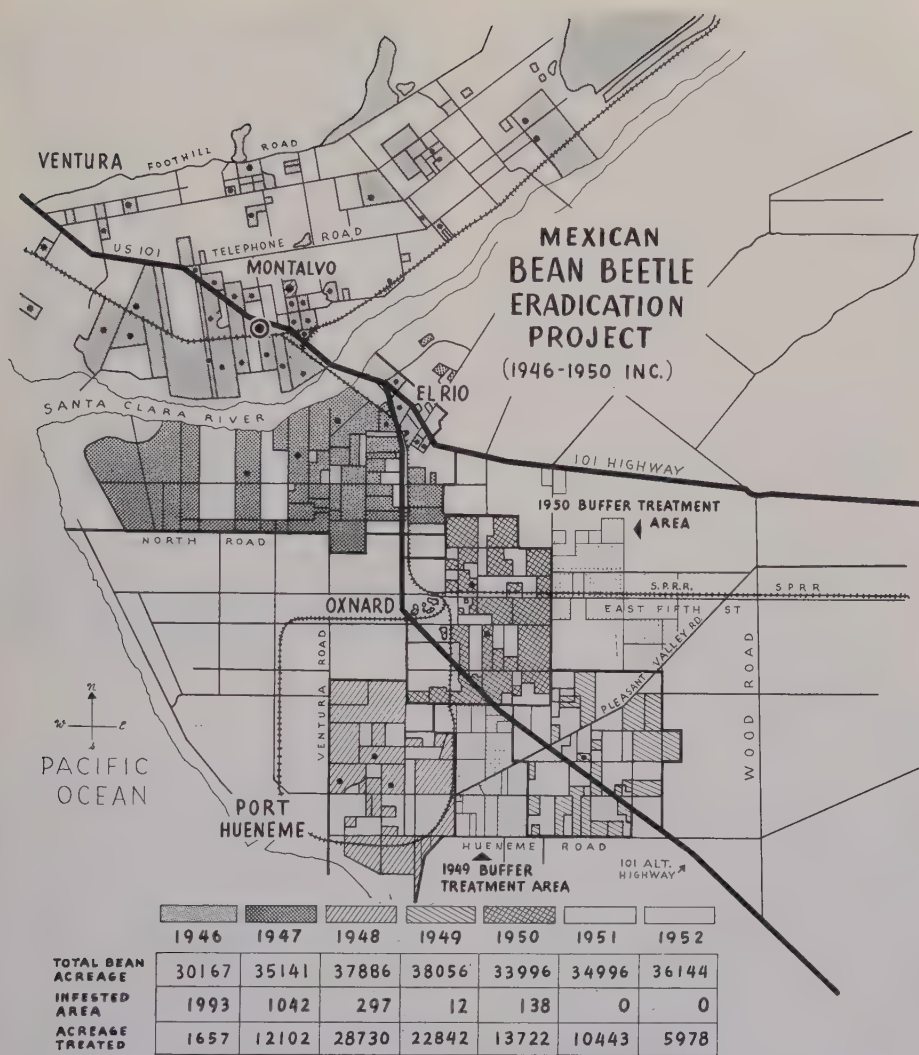
Initial Infestation

The initial known California infestation was restricted to a 25-acre planting well along toward maturity, located in the little community of Montalvo, approximately three miles southeast of the county seat of Ventura. Based on a row count, there were in excess of 4,000,000 estimated adult beetles in the field, exclusive of all other stages which were present in abundance. Tremendous plant damage was already in evidence in the form of leaf skeletonizing. It is needless to point out the dollars and cents value of only a 1 percent loss, if the situation at Montalvo had been accepted as representing a permanently established infestation. The first and only consideration by the department, therefore, was eradication, in spite of the fact that the possibility was emphatically discounted by Eastern authorities.

Through efforts of C. J. Barrett, Ventura County Agricultural Commissioner, an appropriation of \$5,000 was made available by the County Board of Supervisors, an additional \$5,000 by the Ventura County Bean Growers Association, and \$3,000 by the Independent Bean Growers of Ventura County. All such appropriations were used by the commissioner to purchase and destroy the entire infested planting. This was accomplished by first spraying the field with diesel oil, not only to favor burning, but also to discourage outward flight of the adult beetles. Application of oil was followed by burning all vines, which was aided by use of a specially designed boom burner covered by a metal hood, which was drawn slowly by tractor over the field. Burning was followed by plowing under all debris and repeated discing. Within three days the field had been reduced to a state of maximum clean cultivation. Undoubtedly this prompt action by county authorities played an important part in minimizing further outward extension of the infested area.

Some outward spread had already occurred, however, which was expected in view of such high initial infestation. A co-

¹ H. M. Armitage was chief of the department's Bureau of Entomology and Plant Quarantine from June 15, 1944, until September 24, 1948, when the two functions were separated for administrative purposes. Mr. Armitage continued as chief of the Bureau of Entomology until his retirement, November 1, 1955.



operative state-county survey recorded infestation: (1) approximately six miles in a northeasterly direction toward Santa Paula; (2) across the Little Santa Clara River, approximately two miles to the south; and (3) over one mile in the direction of Ventura to the northwest.

During the 1946 season, a total of 66 properties representing 1,923 acres, including 24 backyard gardens, were found infested. The degree of infestation decreased markedly in proportion to the distance from the Montalvo field, which without doubt represented the focal center.

The infested area comprised almost solid contiguous plantings, occasionally interplanted with lemons or walnuts. Many of the fields were separated by windbreaks composed of double or triple parallel rows of eucalyptus interplanted with cypress. Even at ground level, such plantings developed dense foliage which later was found to serve as an ideal place for overwintering adults. This dense foliage undoubtedly played an important part in the success of the suppression effort, an aspect discussed below in more detail.

Cooperation for Control

In response to a request from the department, the late Dr. Neal Howard, in charge of the Federal Mexican Bean Beetle Research Laboratory at Columbus, Ohio, was assigned to California by the United States Department of Agriculture to assist in formulating a suppression or control program. A conference was called upon his arrival, September 17th, 1946, in Commissioner Barrett's office at Santa Paula, attended by state, federal and county regulatory officials as well as representatives of the bean industry.

Based on his knowledge and long experience with the bean beetle in Eastern United States, Dr. Howard, during the conference, tried to discourage any proposals for eradication. In his own support, he pointed out that the beetle was a very strong flyer, with a history of covering up to 3.5 miles in a single day; that it had a very high biotic potential, laying an average of 1,600 eggs with two to three generations a year possible; that adults do not deposit all of their eggs in one spot but may skip-stop across a hundred acres or across a number of properties, leaving 50 to 200 eggs at each stop; that in the fall the adults of the last generation were known to move long distances in search of acceptable hibernating quarters, possibly moving to new areas in the spring; that all winter-hibernating adults did not emerge the following spring, for some carried over to the second year; that any adults emerging from hibernation prior to the seasonal development of the beans may migrate long distances in search of suitable host plants; that visual inspection was woefully inadequate in detecting all existing infestation; that there were undoubtedly weed hosts present in the area or the adjacent foothills which would defeat any suppressive effort by permitting survivals; and most serious of all, that the best known chemicals available for use gave only 90 percent mortality.

Early Discouragement

Dr. Howard completed his discouraging picture by pointing out that spread had apparently already occurred over too wide an area to permit practical suppressive measures. Irregardless of such negative conditions, the conference did propose the following three possible suppressive approaches: (1) establishment of a host-free area to include the entire county, for two or more years; (2)



Mexican bean beetle, *Epilachna varivestres*, adults, larvae, pupa and eggs on the underside of bean leaves

establishment of a quarantine area to include the known infested properties plus a two-mile peripheral area, as a measure of containment within which intensive control might be practiced as a holding program; (3) survey and treatment of infested properties with movement of potential carriers restricted only from infested properties, on a local hold-order basis.

Serious consideration was given to the establishment of a host-free area which would include only the Little Santa Clara Valley, to which all known infestation was restricted. This valley was geographically isolated from other agricultural areas by high rolling hills bordering its entire length on both sides which rise directly from the ocean shore and taper northeastward into non-agricultural mountains; however, the idea was abandoned as economically impractical, since it would have required, for a minimum of two years and perhaps as long as three, total crop elimination from approximately 44,000 acres which represented the 1946 plantings. At stake was an estimated annual farm value of \$5,000,000 for a crop area in which bean growing had been a family vocation for over 75 years. Any new

crops that might have been grown as a part of such a program were already in surplus. Furthermore, no information had then been developed relevant to alternate weed hosts which occur in the adjacent foothills; if present, such hosts would have defeated the program by permitting survivors. There was also a strong possibility that elimination of all host beans from a given area might force dispersal of the strong flying adults to other accessible areas up and down the coast.

Attempt at Eradication Decided

Proposals for possible suppression, listed under (2) and (3) above, offered no hope of complete suppression. If carried out, they would have represented at best only a holding or delaying action against that time when the beetle had to be accepted as an established pest, relegating further control as a matter of individual grower effort. So viewed, the economics of the situation made it clear that at least an attempt at eradication be made.

With respect to the obstacles to eradication suggested by experienced advisors, it was the personal opinion of the writer that the tremendous acreage of contiguous bean plantings, in which the known infestation centered, was sufficiently attractive to hold the relatively small number of beetles against migration, particularly if their numbers were reduced further by remedial measures; that there were ample means of winter hibernation presented in the ground litter under eucalyptus windbreaks lining most fields in the area, litter of a kind sufficiently attractive to depreciate any migration of adults in search of such facilities; that these windbreaks could be treated in such a way, each season, at the proper time to preclude any surviving beetles; that some type of trap crop could be used to hold any adults emerging prior to growth of commercial bean plantings to forestall flight of beetles striking out in search of suitable host plants; and that means of more effective treatment could be developed during a period of intensive delaying treatments.

This proposed approach to eradication received State approval, and funds were made available to put into effect the following eradication program:

1—Winter survey and treatment of backyard gardens (September through May);

2—Elimination of winter hibernation quarters by removing and burning ground litter under all windbreaks lying within direct



John B. Steinweden now Regional Coordinator for Southern California, and Chester J. Barrett, Ventura County Agricultural Commissioner, are shown searching for overwintering adult Mexican bean beetles in ground litter under eucalyptus windbreaks surrounding infested bean fields

flight from known infested fields, and treating the exposed surface soil with an effective chemical to preclude escapes from raking and burning—this operation to be completed before possible emergence could occur (February and March);

3—Planting a trap crop of one or two rows of beans around the periphery of any field found infested the preceding season, in advance of commercial plantings to attract and hold early emerging adults that might otherwise widely disperse; and the trap crop to be dusted repeatedly with a residual chemical (March 1-May 1);

4—Dusting all bean plants within one mile radius of a known infestation, using the most effective chemical available, and making applications at two-week intervals beginning with formation of the second pair of leaves and continuing until harvest (May 15-November 1)—applications to be continued for three years following the finding of any living specimens;

5—Intensive survey of all bean plantings in the county, starting June 1st and continuing through harvesting operations, conducted on the following basis:

a. Within the critical first one-half mile beyond the treatment area, all plantings to be inspected every two weeks on an intensified basis



Lima bean damage caused by Mexican bean beetle

b. Within the second less critical half-mile, all plantings to be inspected every 30 days on a less intensified basis

c. Within the balance of the county, all plantings to be given a scouting inspection at least twice during the season

d. Repeated inspection of backyard gardens during winter months, since beans may be grown in this California area in winter

e. Continuous inspection of bean plantings within the areas of treatment, as a check on results of methods used

f. Inspection of all harvesters or de-viners during harvesting operations to detect possible infestation not found during examination of growing plants;

6—Establishment of a quarantine line to include all plantings within two miles of a known infestation:

a. No movement of a potential host, or of equipment used in harvest or transportation of potential hosts, to be permitted from a known infested property or to any point outside the quarantined area, except after official supervision and certification of approved treatment applied at origin;

7—Development of effective commodity treatments that could be used to alleviate effects of quarantine restrictions.

The foregoing program was carried out with minor modifications based upon experience gained as the program itself developed. All measures continued until successful completion of the project which was terminated November 1st, 1955.

Field Studies Begun

During the fall and winter of 1946 and the spring of 1947, the Division of Truck Crop and Garden Insect Control in the then Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, accepted an invitation from the California department to carry out special field studies in the infested area to develop information needed to carry out the proposed eradication program. J. C. Elmore of the Alhambra Laboratory, who was assigned to these studies, established headquarters at the field laboratory maintained in Ventura under M. W. Stone. To facilitate the studies, a greenhouse was loaned and moved from Alhambra to Ventura for use in studying potential weed hosts and development of effective chemicals for control.

As a result of such field studies, 17 suspected weed hosts collected in the problem area were all found negative. No species was found anywhere in the area that would support infestation through a complete cycle



Trash in orchards and windrows adjacent to Mexican bean beetle infestations was raked and burned in order to destroy hibernating quarters of the insect

of the bean beetle. This was extremely encouraging from the standpoint of suppression plans and eliminated one deterrent factor.

The results of life history studies were particularly helpful in effectively timing various phases of the programmed activities. It was thereby proved that no activity of the beetle could occur during winter months in home gardens regardless of the facility in growing beans at that time and under those conditions. It was definitely established that the beetle could survive the winter under California conditions, 30 percent having emerged in outdoor cage tests by the first week in June, compared with 9.7 percent at Chattanooga, Tennessee, 15 percent at Birmingham, Alabama, and 30 percent at Thomasville, Georgia. Adult emergence from hibernation was known to be associated closely with moisture and usually followed light rains or heavy, dripping fogs, at temperatures varying from 58 degrees to 69 degrees F., conditions common to Ventura County and confirmed by cage records. Eggs and larvae were reported killed at 100 degrees F. in the greenhouse, while adults hid out in the moist ground litter. It was determined that two and one-half to three generations could be expected under California conditions, with a complete life cycle ranging from 40 to 45 days. Further, it was found that adult beetles could live without food

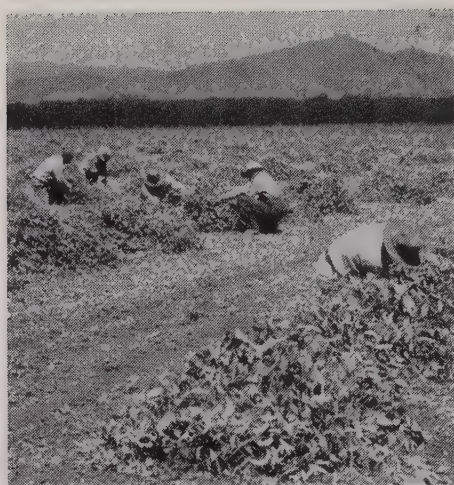
for as long as 82 days under optimum moisture conditions—without moisture the maximum record was 30 days. First emergence in the field was recorded on May 13th, compared with March 28th in the outdoor cage.

John Steinweden of the California Department of Agriculture, using the federal facilities, conducted tests concurrently with the life history studies on 37 different insecticides of potential value; none showed more favorable than 1 percent rotenone, except that addition of 2-3 percent lethane seemed to increase slightly the effectiveness of the latter.

Following conclusion of the studies discussed above, all laboratory material was destroyed in mid-summer of 1947, since its further presence was not compatible with the suppression program.

Host Litter Sprayed

Each spring during February and March, a crew of 10 state workers under county supervision was employed for two months in removing and burning ground litter under windbreaks lying in direct line of flight from known infested fields. The surface area thus exposed was then thoroughly sprayed with pyrethrum, 1 to 400, as developed by John Steinweden, to destroy beetles that survived the raking and burning. These measures were carried out well in advance of possible adult emergence from such cover, and were



Harvested beans were inspected for possible surviving Mexican bean beetle adults. This infested field was kept under treatment during the growing season.

presumed to destroy all beetles that might be present. From 5 to 10 miles of windbreak were thus cleaned each season. The accumulated litter was from one to three feet deep the first season and presented a formidable removal problem.

Late in 1946, examination of the windbreak directly north of the originally infested field produced evidence of numerous dead adults, indicating that infestation must have been present during 1945. After the second year of these windbreak operations, no additional adults were found. No adults were ever found under roadside weeds or around buildings, although a few were found hiding temporarily under cocked or wind-rowed beans left to dry after cutting. An appreciable number of live beetles, found during the first autumn, were associated with harvested trash; one adult was also found in a sack of threshed beans. As a result of these findings, survey attention was given all areas with comparable conditions, throughout the suppression program; but negative results were noted after the second year.

Trap Bean Rows Planted

During each year an effort was made, before the regular planting season, to develop one or two rows of beans around the periphery of fields known to have carried infestation the preceding season, in the hope that these early beans would serve to attract and hold adults emerging from hibernation before the normal time. It was not always

possible to do so, since moisture and temperature were not favorable to desired pre-season growth; however, early bean plantings were attempted each season, and by the second year they were found to have served their purpose. Such trap beans were not only kept under periodic inspection but were destroyed before an existing infestation could develop to the point where it served possibly to continue infestation in commercial plantings. The County of Ventura carried out these measures each season, using seed furnished by the State.

Chemical Applications Scheduled

Due to the inadequacies of visual inspection, it was arbitrarily decided to cover with an effective chemical all beans growing within one mile of a known infestation, from the time the second pair of leaves formed until harvest. Applications were scheduled to be made at two-week intervals throughout the growing season and arbitrarily continued for three years following the last finding of a live specimen, including the year of finding.

Early information furnished by the United States Department of Agriculture indicated that .75 percent rotenone applied as a dust in talc was the most effective material known against adults and larvae. Cryolite-60 was recommended as a substitute in the event rotenone was not available. Bean foliage was apparently intolerant to other chemicals that otherwise might have been used effectively. Unfortunately rotenone had an efficiency rating of only 90 percent against the bean beetle, whose biotic potential permitted survival at 99.6 percent mortality.

Because of the lack of a more efficient agent, .75 percent rotenone was used for initial applications. Later, on the basis of favorable studies by John Steinweden, department entomologist, 2 to 3 percent lethane-60 was added. All applications during 1946 were made at the rate of 50 pounds per acre, because of vine maturity and high volume of foliage present at the time. Under this program there remained an unexplained relatively large number of adults at the close of the season. Consequently it was decided to use 1 percent rotenone alone during following seasons. The chemical was applied at the rate of 25 pounds per acre for the first application when plants were small; at 35 pounds per acre for the second application, as plants developed more foliage; and at 50 pounds per acre as plants matured and vines



A Ventura County hard-top road served as an air strip for this helicopter parked for servicing and loading of rotenone dust

covered the space between rows. Although the first two applications were made using ground machines, airplanes were used for the last three to prevent damage to vines that would have resulted from use of ground rigs. Glass slide tests proved the two methods to be effective in covering both sides of the bean foliage, although coverage was less complete on the underside where most needed.

The above procedure was conducted throughout the entire treatment program, from July, 1946, through September, 1952. The latter date represented three treatment seasons following the last finding of a living specimen on July 27th, 1950, including the year of finding. In all, 4,064,717 pounds of material were applied to 96,435 acres of beans in maintaining this schedule, as shown in Table 1. Peak treatments occurred in 1948, when approximately 7,000 acres were given four complete and a fifth partial application of dust. Treated acreage subsequently declined to approximately 1,200 acres in 1952 when close to five complete coverings were made. Late in the program 50 percent sulfur was substituted for an equal amount of talc in the carrier to compensate for a buildup in aphids and spider mite, which occurred under continued application of rotenone.

All treatment applications were made using materials also furnished by the State, and under contracts financed by the State. Supervision of contract operations was by county personnel.

As previously stated, the history of 1 percent rotenone as used in the control of the Mexican bean beetle in the eastern United States was only 90 percent efficient; however, it was observed when similarly used in California that, although live adult beetles were later noted in treated fields, no reproduction was recorded or indicated under such conditions. All new infestations as found were restricted to premises not previously treated.

Survey for New Infestation

Field survey to detect existing new infestation was initiated June 15th of each year, though it was recognized there was greater possibility of finding infestation during July or August after one or more generations had permitted the beetle to build up to detectable numbers. It was important, however, that all infestations be found as early in the season as possible, if eradication were to be accomplished. Inspection was continued each season through the harvest, including examination of harvested trash and the final harvested beans.

Ventura County, using 10 men, assumed responsibility for continuous repeated inspections of all backyard gardens and treated areas. The California Department of Agriculture, using 35 to 50 men, devoted its whole attention to field plantings outside treated areas. These department personnel were organized into crews of five each, one of whom acted as leader. As previously planned, all plantings in the critical first half-mile outside the treated area were in-

TABLE 1
Acreage Involved and Materials Used in Mexican Bean Beetle Eradication Program

Year	Total acreage				Lbs. material used ²
	Planted	Inspected	Infested	Treated	
1946	30,167	25,934	1,973	2,609	80,550
1947	35,141	53,039	1,042	12,102	530,400
1948	37,886	59,371	297	28,730	1,230,837
1949	38,056	147,009	12	22,842	943,730
1950	33,996	81,270	138	13,722	591,850
1951	34,996	86,483	0	10,443	435,250
1952	36,144	56,976	0	5,987	252,100
1953	37,185	84,199	0	0	0
1954	40,000	87,438	0	0	0
1955	38,000	59,764	0	0	0
Totals		741,483	3,462	96,435	4,064,717
Average	36,158				

² One percent rotenone in talc, applied at rate of 25, 35 and 50 pounds per acre respectively in relation to the growth of the plants. In late season, 50 percent sulfur was substituted for an equal amount of talc to control aphids and spider mites which developed in the presence of rotenone.

spected every two weeks throughout the season—the inspector covered six rows, three on either side, as he crossed a field. In the second less critical half-mile outside the treated area, a similar procedure was followed every 30 days—the inspector there covered 12 rows, six on either side, as he crossed the field. All other plantings in the county were covered twice during the season on a scouting basis only, with the inspector covering 24 rows, 12 on each side, as he crossed the field. It will be noted in Table 1 that seasonal total inspections in terms of acreage were two to three times as large as the total planted acreage of the county.

In order to sustain the interest of inspectors after days, weeks, months and perhaps years of negative findings, crews were assembled at regular intervals and shown enlarged kodachrome film of the various life history stages of the bean beetle and typical plant damage. Also to maintain interest, inspectors were asked to collect insects associated with the bean plants, avoiding replications as much as possible. Specimens were later identified either by the county entomologist or by a department entomologist in Sacramento. An excellent cross section of all insect life associated with beans in the eradication area has therefore been accumulated as a result, comprised of 5,962 specimens representing 708 species from 168 families in 17 of the 28 recognized orders of insects.

The presence of numerous cucumber beetles, *Diabrotica scror*, with leaf damage resembling that of the bean beetle, until closely examined, had a tendency to slow down survey operations.

During the course of survey, 741,483 acres of beans were inspected (Table 1), as a result of which 97 properties, including 32 backyard gardens, were found infested (Table 2); total acreage of combined properties on which infestation was found comprised 3,462 acres. Infestation as determined by survey persisted over a period of five years including 1946, the year of its finding; the last finding was made July 31st, 1950. Following the initial heavy infestation of 1946, all subsequent infestations were restricted, in effect, to isolated specimens on isolated individual plants at widely scattered spots. In reality, after 1946 the total number of beetles taken in any stage included only 666 adults, 1,076 larvae, and 168 egg masses.

New Infestations Controlled

It is significant to note that at the time of finding new infestations during 1947-48 and 1949, evidence showed that first generation larvae had matured and pupated and that adults had escaped. It was not until 1950 that all recorded new infestations were found before such a situation had developed, and the beetle's opportunity to continue outward spread prevented by timely control measures.

TABLE 2
Periods and Extent of Actual Infestation Involved in Mexican Bean Beetle Eradication

	Date found		No. and stage			Infested		
	First	Last	Eggs	Larva	Adults	Yards	Ranches	Acres
1946	7/22					24	42	1,973
1947	5/31	8/21	89	331	304	7	17	1,042
1948	8/18	8/27	78	217	318	1	3	297
1949	8/31	8/31	1	5	44	0	1	12
1950	7/27	7/27	0	523	0	0	2	138
There were no findings subsequent to 7/27/50.								
Totals			168	1,076	666	32	65	3,462



A standard survey crew operated in the critical area examining six rows, three on either side of them, as they crossed the bean field

With respect to the new infestations cited above, the practice was established of immediately calling in all inspection personnel to make a leaf-by-leaf inspection and handpick and destroy, on the spot, all specimens of the beetle in any stage that could be found. Infested plants were then pulled, piled and burned on the spot. All vines within a radius of 50 feet were immediately and thoroughly hand dusted with 1 percent rotenone. Within 24 hours the whole property on which infested plants had been found was similarly dusted by ground machine; within a week all plantings within one mile were similarly dusted by plane. As a part of this regular plan, plants within the one-mile radius were dusted every two weeks throughout the growing season for three consecutive years, regardless of further survey findings.

Infestation Restricted to Ventura

During 1947 final reports from 30 counties, representing 210,152 acres, showed requested survey completed with negative findings in 15 counties representing 122,041 acres. During 1949 such inspection was extended by county agricultural commissioners to 105,129 acres in 14 counties; negative results were also reported at that time. It was, therefore, assumed at the time, pending confirmation which was later received, that infestation

had been restricted to Ventura County. Inspections were continued each year along the California coast to the north in Santa Barbara County, and south in Los Angeles County where there was a possibility of infestation through natural flight; no infestations were found. Inspection was also extended for five consecutive years to the Venice area in Los Angeles County which had received green beans for quick freezing from the infested areas before infestation was known. These inspections also resulted in negative findings.

Until effective quarantine measures were established, Commissioner Barrett used his legal authority to place hold orders against all known infested premises. Under such orders, no potential host carriers—beans in any form, either dry or fresh, or as vines or straw—or equipment used in their harvesting or transportation were allowed to move except under officially certified approved and supervised treatment at point of origin.

Quarantine lines, as later established well beyond the limits of known infestation, recognized both infested and regulated areas. Host material and equipment was allowed to be moved within the regulated area without certification or treatment, but could not be moved from a known infested property or

from the regulated area to a point outside. All quarantine regulations were revoked when treatment measures were completed in November, 1952, in view of the fact that no living specimens of bean beetle had been taken during the previous two and one-half years.

Fumigation Schedules Developed

In order to meet the otherwise prohibitory provisions of the quarantine regulations, effective treatments acceptable to other areas had to be developed. John Steinweden surveyed the problem and did develop fumigation schedules which were put into effect, permitting movement of potential host carriers from infested areas as defined by quarantine. The schedules were as follows:

Methyl Bromide (under gastight tarpaulins)

	Lbs.	° F.	Hrs. per M/cf
Green beans	4	60	2
Green beans	3.5	70	2
Green beans	3	80	2
Dry beans	2	60	12
Bean straw	2	60	12
Bean straw	1	60	24

Hydrocyanic Acid ^a

	Oz.	° F.	Hrs. per C/cf
Equipment	2	50	1

^a Sodium cyanide or its equivalent of 20 cc liquid HCN.

These quarantine measures were officially approved and continued effectively throughout the project's treatment period. Unfortunately no complete records were maintained for fumigation of commodities transported in conformity with quarantine requirements. Statistics for 1948, however, are significant; during the year there were fumigated 119 tons of green beans, 144,417 cubic feet of bean straw, 3,391 sacks of dry lima beans, 2,003 lugs of green beans, 1,407 lugs of green beans for quick freeze, and 319 miscellaneous vehicles. All fumigation was under contract with the California Department of Agriculture. Materials were furnished by the department and work was supervised by the county commissioner. The volume of material treated during 1948 is typical of each year the quarantine was in force, 1946 through 1950.

Eradication Cost Relatively Small

The over-all cost of California's Mexican bean beetle eradication program was \$981,352, of which \$879,974 represented state funds and \$93,378 county funds. In addition, the Ventura County Bean Growers Association contributed \$5,000 and the Independent Bean Growers of Ventura County, \$3,000, made available at a critical time before public

funds were authorized. The total cost of eradication projects was less than 2 percent of a single year's return to growers from the crop protected. If the beetle had been accepted as established, a minimum annual control cost of \$8 per acre would have had to be shouldered by all owners of infested properties, with rather definite assurance that such infestation eventually would have been quite general. This does not take into consideration crop loss which, as previously stated, has been total in Eastern United States.

Cooperating Agencies

Eradication of the Mexican bean beetle in California was the result of effective cooperation on the part of everyone concerned, including state, federal and county officials, growers and other residents of the eradication area. The program was devised and primarily financed by the California Department of Agriculture; federal authorities, represented by the former Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, furnished essential biological and control information; the Ventura County Agricultural Commissioner, C. A. Barrett, and his deputy, John Allee, furnished considerable direct field supervision for various phases of the program, made possible by an appreciable fund appropriated by the Ventura County Board of Supervisors.

Special mention is merited by John Steinweden, an entomologist with the California Department of Agriculture at the time, who effectively initiated and supervised the eradication program during its first two years; Mr. Steinweden left the project to become regional coordinator, representing the department in Southern California. Ted Gallion, a department entomologist, also deserves special mention. He had the tedious job of organizing and supervising survey crews each year, and maintaining their interest over the years in the face of negative findings. Last but not least, the friendly cooperation is acknowledged of all growers and residents who were seriously inconvenienced by the continual dusting far beyond apparent indication of need. Without such understanding and all the assistance and cooperation noted above, successful eradication could not have been accomplished.

It is important that the possibility of reintroduction of the beetle be reviewed and adequate safeguards established against such a development.

Symptoms for Identifying Fanleaf in Dormant Grapevines

By WM. B. HEWITT, *Plant Pathologist, Department of Plant Pathology, and*
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Fanleaf disease of grapevines is one of the principal causes of vineyard decline in California. This disease occurs in many parts of the State and has apparently been present in California for many years. However, it has been spreading very rapidly during the past few years (6). Though fanleaf is soil borne (8), its spread is mostly through the distribution of diseased rootstocks and scion wood. This spread of fanleaf and of some other similar diseases of grapevines can be stopped simply by propagating and distributing only healthy stock which has been grown in clean soil.

If vineyardists and nurserymen would carefully examine the vines from which they wish to propagate, and would gather propagating wood only from the healthy vines which have produced excellent crops that have matured normally, they could themselves eliminate many of the disease problems that are present today.

Symptoms of fanleaf can be seen easily in the foliage of many varieties and rootstocks during the early season's shoot growth. The leaf mottling and deformities characteristic of fanleaf (7) become less distinct and increasingly difficult to distinguish in the mid- and late-season growth on diseased vines. This is especially so in vines with mild cases of fanleaf disease.

Because growers often delay a decision to plant new vineyards until the year's crop has been harvested or until the vines are dormant, it is essential to be able to recognize diseased vines at different times of the year.

Short Internodes, Double Nodes, Fasciations

Malformations of grape canes in vines with fanleaf are symptoms that can be seen when the vines are dormant. These deformities occur as short internodes, double nodes, fasciations, zigzag growth of canes, small and often flat canes. Some of these cane deformities are shown in Figure 1. One and often more of them have been found on individual canes of fanleaf-diseased vines.

These malformations of grape canes have been observed and pointed out by those

studying the disease in other countries of the world (1, 2, 3, 4, 5, 9). References are made to a limited number of the papers describing these anomalous cane forms. This is done primarily to point out that these symptoms are known and considered an important factor in diagnosing the disease in other countries.

Cane deformities have been found associated with fanleaf in many varieties of grapes growing in California. The number of these deformities apparently has varied with the stage of disease, the season, and the variety. A study of these cane anomalies was undertaken to determine their value in distinguishing fanleaf in grapevines in California.

All of the vines in the vineyards in the Santa Clara Valley where these studies were made showed foliage, cane, and cluster symptoms of fanleaf. When graded as to severity they ranged from mild to severe. Vines without fanleaf or some other disease were difficult to find in these vineyards. Therefore, in order to be reasonably certain in the choice of normal vines, for comparison in the studies, vines in the vineyard of the Department of Viticulture at Davis that had good harvest records and that had been observed previously for foliage symptoms were used. Canes of all vines were examined during dormancy when there were no leaves on the vines.

The occurrence of malformations of the grape canes grown in the 1953 and 1954 seasons on fanleaf diseased vines was tabulated. All canes on a vine were examined. Each was classed as to origin, i.e., from spurs, fruiting canes or suckers, and the internode position of the deformity was counted from the base of the cane (Tables 1-4). The tabulated results show: 1, the total numbers of canes examined; 2, the numbers of canes with the respective deformities; 3, the percent of canes with the deformity; 4, the total number of deformities found; and 5, the number per cane based on the total number of canes examined.

Table 1 presents the data for the variety French Colombard, Table 2 for Pinot Char-



FIG. 1. Some abnormalities found in canes on A, French Colombard, and B, Pinot Chardonnay vines with fanleaf; a, short internodes; b, double nodes; c, fasciation, and d, small flat canes.

donnay, and Table 3 for Pinot Blanc. Similar data showing the numbers of deformities in canes of four varieties of healthy vines in the experimental vineyards at Davis are presented in Table 4.

The frequency of the short internodes and their distribution along the cane of healthy and diseased vines of the variety French Colombard are shown in Figure 2 and of the variety Pinot Chardonnay in Figure 3.

Vines with fanleaf had numerous deformities in the canes. They averaged over two per cane for all canes observed. On the other hand, healthy vines had very few malformations averaging only 0.005 to 0.023 per cane for all canes observed. Short internodes were the most frequent of the various forms of the cane deformities observed. They occurred on approximately 78 to 92 percent of the canes on vines with fanleaf and on only 0.5 to 2.4 percent of the canes on healthy vines. These deformities of canes on healthy vines were mostly in the form of short internodes or an occasional double node. On fanleaf vines the number of short internodes per cane based on the total canes observed ranged from 1.14 to as high as three. Canes of different origin had varying numbers of short internodes, but there was no consistent difference. There were more short internodes in the 1953 season canes than in those grown in 1954 on vines of French Colombard. The reverse was found with Pinot Chardonnay but this difference in number was very small and probably not significant.

The frequency and distribution charts showing the number of short internodes along the cane from the base are illustrated in Figures 2 and 3. They show that the short internodes may occur in almost any position along the cane. In fanleaf vines the short internodes were most frequent in the 8th to 15th internode in canes of French Colombard and in the 5th to 15th internodes of Pinot Chardonnay canes. In the latter (Fig. 3) the frequency peak of short internodes in the 1954 canes shifted toward the base as compared to that in the 1953 canes. The total number of canes examined in each of these two seasons was in excess of 1,000 so these differences may well represent seasonal variability. However, this difference was not found on canes of French Colombard vines.

When two nodes occurred together and opposite each other on the cane, the pair was classed as a double node. This anomaly is probably an extremely short internode. Neither the total number nor the frequency of double nodes was high, especially when compared to the number of short internodes. However, more double nodes were found on fanleaf vines than on healthy vines; also they were even more abundant in the 1954 than in the 1953 canes of French Colombard and Pinot Chardonnay.

Other types of deformities in the grape canes, especially fasciations, were more frequent in the 1953 than in the 1954 wood of the French Colombard. However, this difference was not apparent in the canes of Pinot Chardonnay.

Conclusions

It is apparent from these studies that vines which show leaf symptoms of fanleaf have a high frequency of cane deformities as compared to those of healthy vines. The infrequent occurrence of short internodes and double nodes as such is not sufficient evidence of fanleaf. However, when the frequency of these deformities exceeds one per vine there is reason to question the health of the vine. When the frequency is in the area of one to every other cane or more

there is good evidence that a vine has fanleaf.

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TABLE 1
The Numbers of Short Internodes, Double Nodes and Fasciations Found on Canes Grown in 1953 and 1954 on Vines of the Variety French Colombard With Fanleaf Disease

Malformations and type of cane as to origin	No. of canes with	% of canes with	No. counted	No./cane total canes
CANES GROWN IN 1953				
Short Internodes				
Spur canes	1,039	93.1	3,285	2.94
Fruiting canes	12	80.0	45	3.00
Sucker canes	199	90.0	587	2.66
Totals	1,250	92.6	3,917	2.90
Double Nodes				
Spur canes	116	10.4	132	.12
Fruiting canes	2	13.3	2	.13
Sucker canes	20	9.0	22	.10
Totals	138	10.21	156	.12
Fasciations				
Spur canes	181	16.2	196	.18
Fruiting canes	2	13.3	2	.13
Sucker canes	40	18.1	45	.20
Totals	223	16.5	243	.18

Total number of canes counted: Spur Canes, 1,116; Fruiting Canes, 15; Sucker Canes, 221—Total, 1,352.

CANES GROWN IN 1954				
Short Internodes				
Spur canes	1,047	84.8	2,518	2.40
Fruiting canes	232	61.7	429	1.14
Sucker canes	272	76.8	569	1.61
Totals	1,551	78.9	3,516	1.79
Double Nodes				
Spur canes	365	29.6	446	.36
Fruiting canes	64	17.0	80	.21
Sucker canes	86	24.3	111	.31
Totals	515	26.2	637	.32
Fasciations				
Spur canes	47	3.8	50	.04
Fruiting canes	5	1.4	5	.01
Sucker canes	12	3.4	12	.03
Totals	64	3.3	67	.03

Total number of canes counted: Spur Canes, 1,235; Fruiting Canes, 376; Sucker Canes, 354—Total 1,965.

TABLE 2
The Numbers of Short Internodes, Double Nodes and Fasciations Found on Canes Grown in 1953 and 1954 on Vines of the Variety Pinot Chardonnay With Fanleaf Disease

Malformations and type of cane as to origin	No. of canes with	% of canes with	No. counted	No./cane total canes
CANES GROWN IN 1953				
Short Internodes				
Spur canes	460	81.7	1,212	2.16
Fruiting canes	362	87.9	1,005	2.44
Sucker canes	221	78.4	544	1.93
Totals	1,043	83.0	2,761	2.20
Double Nodes				
Spur canes	65	11.5	77	.14
Fruiting canes	50	12.1	57	.14
Sucker canes	23	8.2	27	.10
Totals	138	11.0	161	.13
Fasciations				
Spur canes	22	3.9	25	.04
Fruiting canes	15	3.6	16	.04
Sucker canes	17	6.0	18	.06
Totals	54	4.1	59	.05

Total number of canes counted: Spur Canes, 563; Fruiting Canes, 412; Sucker Canes, 282—Total 1,257.

CANES GROWN IN 1954				
Short Internodes				
Spur canes	380	85.4	1,242	2.79
Fruiting canes	9	69.2	23	1.77
Sucker canes	428	72.4	1,131	1.91
Totals	817	77.9	2,396	2.28
Double Nodes				
Spur canes	103	23.1	144	.32
Fruiting canes	0		0	
Sucker canes	80	13.5	94	.16
Totals	183	17.4	238	.23
Fasciations				
Spur canes	30	6.7	31	.07
Fruiting canes	0		0	
Sucker canes	22	3.7	23	.04
Totals	52	5.0	54	.05

Total number of canes counted: Spur Canes, 445; Fruiting Canes, 13; Sucker Canes, 591—Total, 1,049.

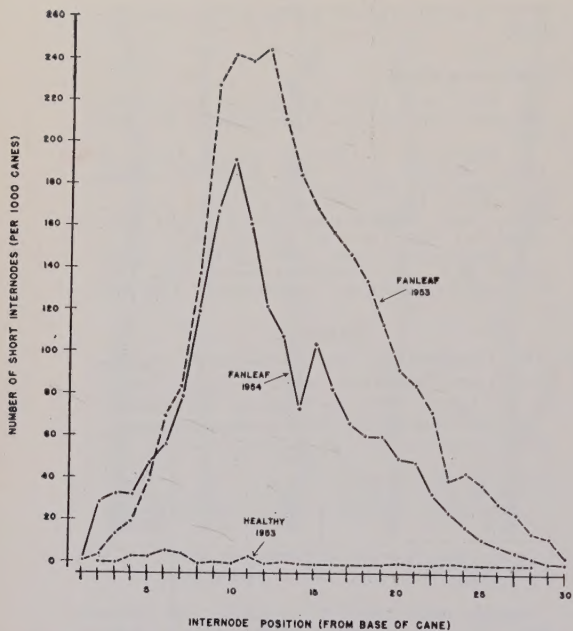


FIG. 2. The frequency and distribution of short internodes from the base to the tip of canes of fanleaf diseased French Colombard vines. The broken line shows data for 1953 and the solid line for 1954 canes.

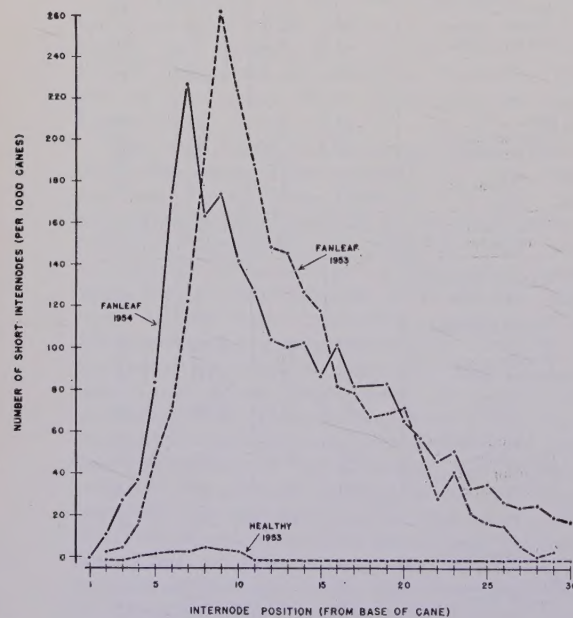


FIG. 3. The frequency and distribution of short internodes from the base to the tip of canes of fanleaf diseased Pinot Chardonnay vines. The broken line shows the data for 1953 and the solid line for 1954 canes.

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TABLE 3

The Numbers of Short Internodes, Double Nodes and Fasciations Found on Canes Grown in 1953 on Vines of the Variety Pinot Blanc With Fanleaf Disease

Malformations and type of cane as to origin	No. of canes with	% of canes with	No. counted	No./cane total canes
CANES GROWN IN 1953				
Short Internodes				
Spur canes.....	332	83.4	874	2.20
Fruiting canes.....	0		0	
Sucker canes.....	40	74.1	95	1.76
Totals.....	372	82.3	969	2.14
Double Nodes				
Spur canes.....	24	6.0	25	.06
Fruiting canes.....	0		0	
Sucker canes.....	3	5.6	3	.06
Totals.....	27	6.0	28	.06
Fasciations				
Spur canes.....	74	18.6	78	.20
Fruiting canes.....	0		0	
Sucker canes.....	6	11.0	6	.11
Totals.....	80	17.7	84	.19

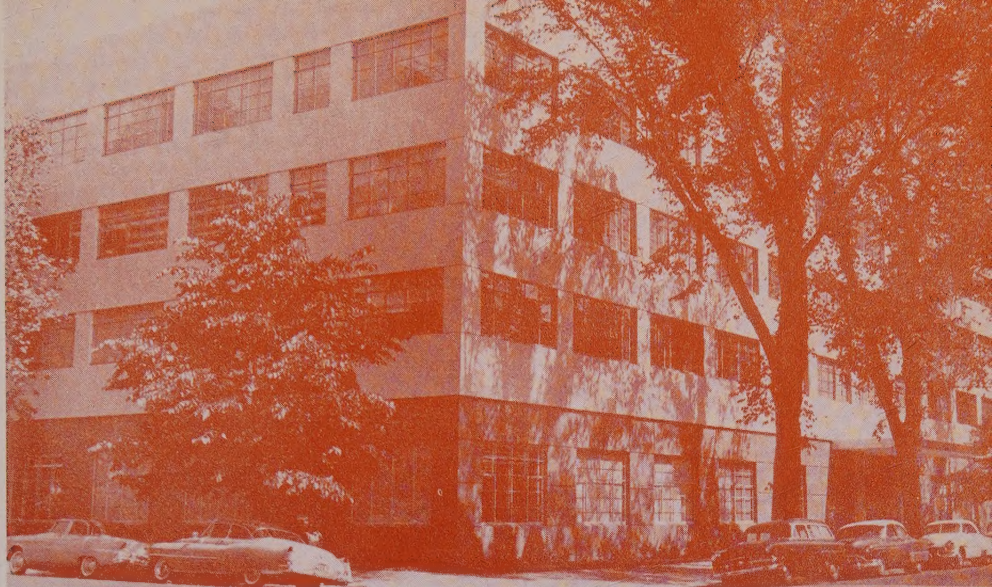
Total number of canes counted: Spur Canes, 398; Fruiting Canes, 0; Sucker Canes, 54—Total 452.

TABLE 4

The Numbers of Deformities Found on Canes of Healthy Grape Vines of Four Varieties Growing at Davis in 1953

Variety	No. of canes with	% of canes with	Total counted	No./cane total canes
French Colombard.....	16	2.4	17	0.025
Pinot Chardonnay.....	9	1.9	10	0.022
Pinot Blanc.....	2	0.5	2	0.005
Folle Blanche.....	16	1.9	37	0.045

Total number of canes counted: French Colombard, 663; Pinot Chardonnay, 461; Pinot Blanc, 429; Folle Blanche, 825.



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